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Title: IDENTIFINDER Overview and Operation

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# IDENTIFINDER Overview and Operation

## Fundamentals of Non-Destructive Assay for International Safeguards

Los Alamos National Laboratory  
September 26, 2017

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-  **SAFEGUARD** NUCLEAR MATERIALS TO PREVENT THEIR DIVERSION OR THEFT
-  **CONTROL** THE SPREAD OF WMD-RELATED MATERIAL, EQUIPMENT AND TECHNOLOGY
-  NEGOTIATE, MONITOR AND **VERIFY** COMPLIANCE WITH INTERNATIONAL NONPROLIFERATION AND ARMS CONTROL TREATIES AND AGREEMENTS
-  **DEVELOP** PROGRAMS AND STRATEGIES TO ADDRESS EMERGING NONPROLIFERATION AND ARMS CONTROL THREATS AND CHALLENGES



## Terminal Learning Objective

- Explain the measurement applications of the HM-5 (IdentiFINDER)
- Demonstrate operation of the HM-5 IdentiFINDER

## Enabling Learning Objectives

1. Describe the features and application of the HM-5
2. Describe the Finder Mode Feature
3. Describe the isotope identification feature
4. Describe the U/Pu verification feature
5. Describe the active length measurement feature
6. Describe the enrichment measurement feature
7. Familiarization with the operation of the HM-5

## Enabling Learning Objectives

8. Locate sources using the Finder Mode
9. Identify sources
10. Perform verification measurements of U and/or Pu
11. Measure the active length of a fuel rod or assembly
12. Measure the enrichment of an uranium item
13. Quantify the limits of the measurement techniques by varying measurement conditions

## General Description

- Portable hand-held radionuclide detection and identification device
- Automatic calibration and continuous stabilization
- Digital signal processing
- Visible and audible alarms
- Nuclide ID based on template matching
- Saving and downloading spectra to the PC





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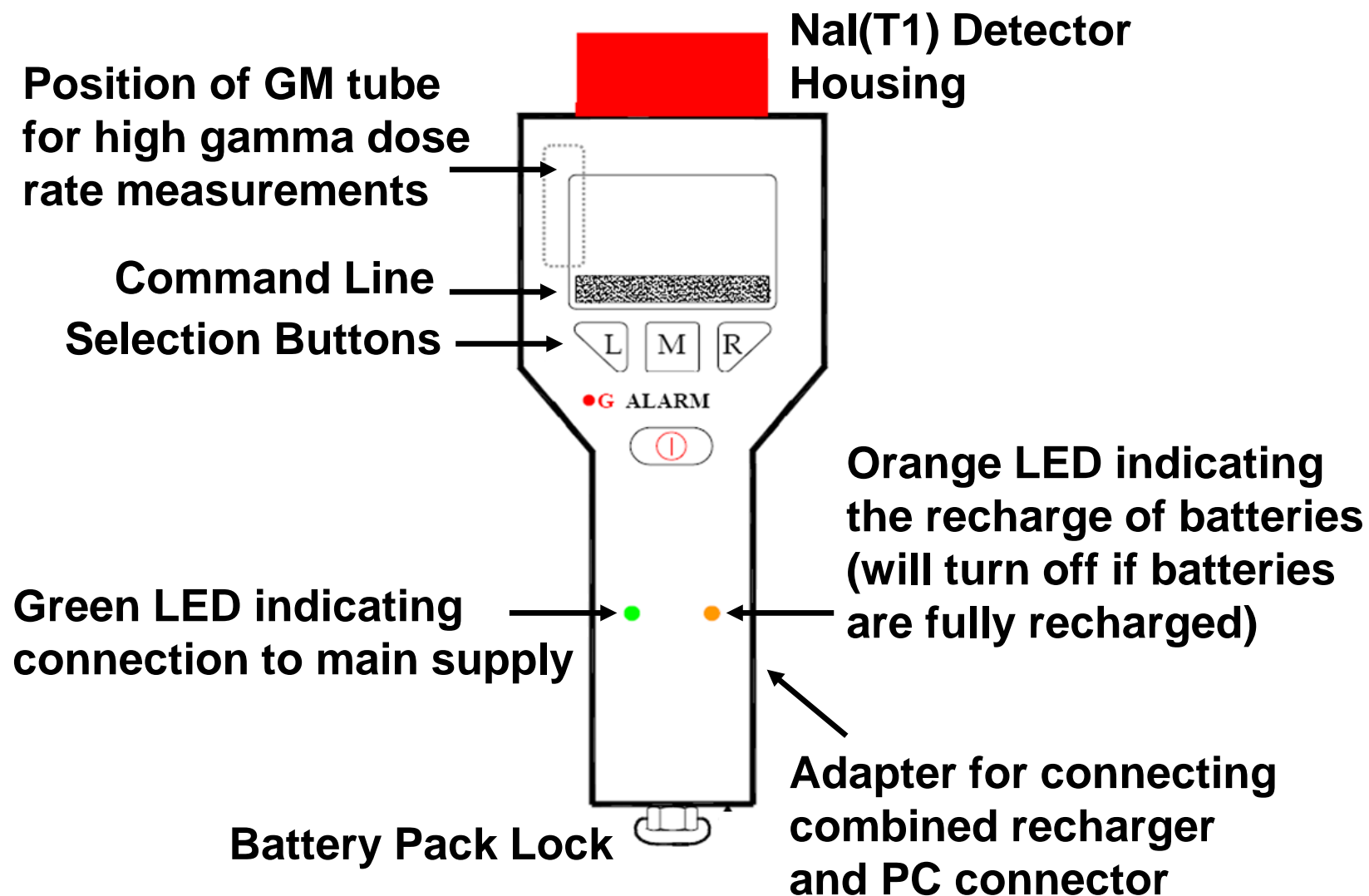
## Applications for Safeguards

- Nuclear material presence verification
- Nuclear material location and distribution
- Isotope identification
- Uranium enrichment measurement (with built-in NaIGEM software)





# identiFINDER Layout



# Instrument Assembly



Note: some models do not allow for removing the collimator cap.

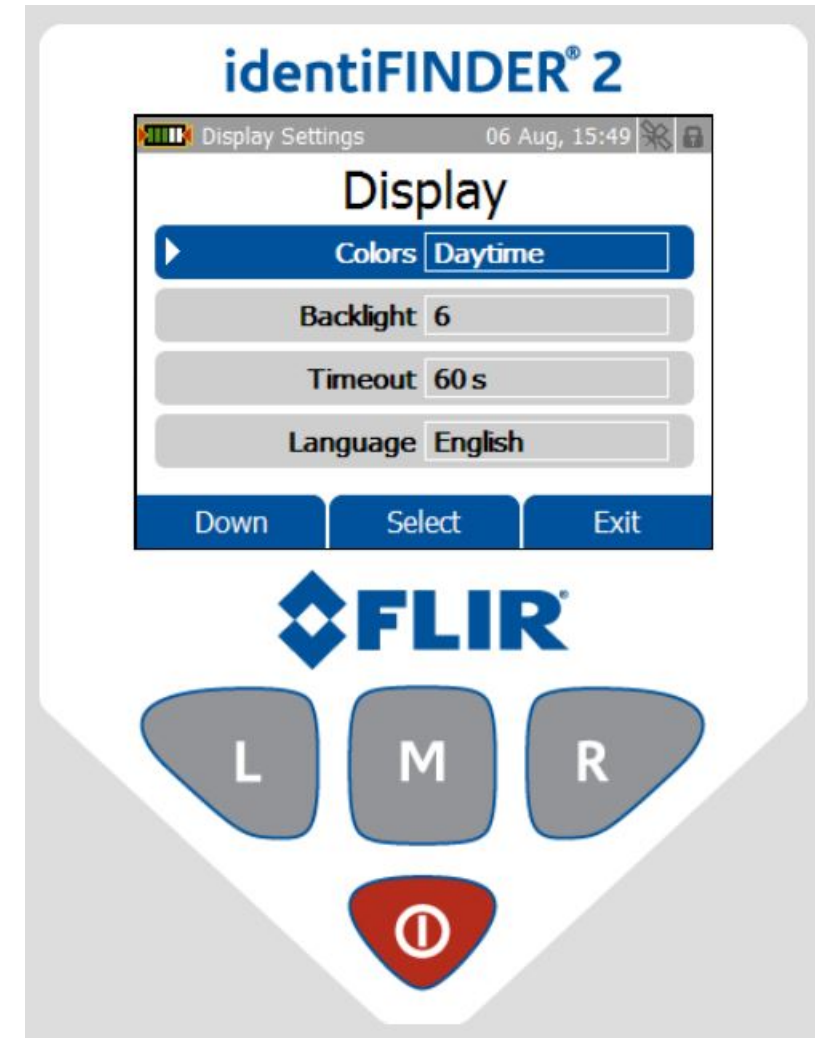
Cap with  
 $^{137}\text{Cs}$  check  
source

Collimator  
cap

Tungsten  
collimator

# Buttons

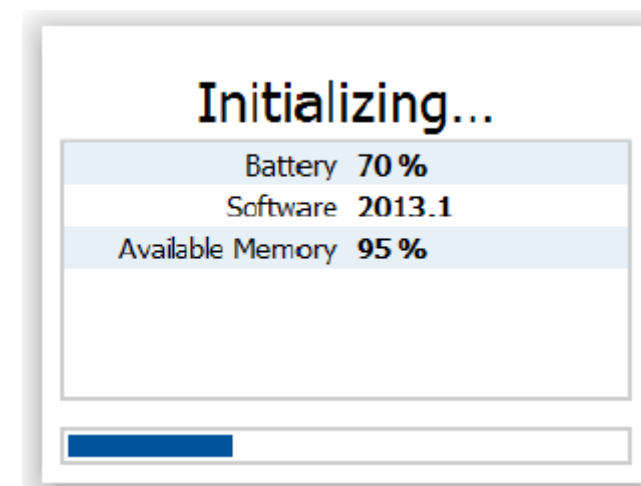
- There are three multifunction keys displayed in the inverted menu line: left, middle, right
  - L key is often used to toggle through menu options
  - M key is used to select items
  - R key is often used to EXIT





## Starting identiFINDER

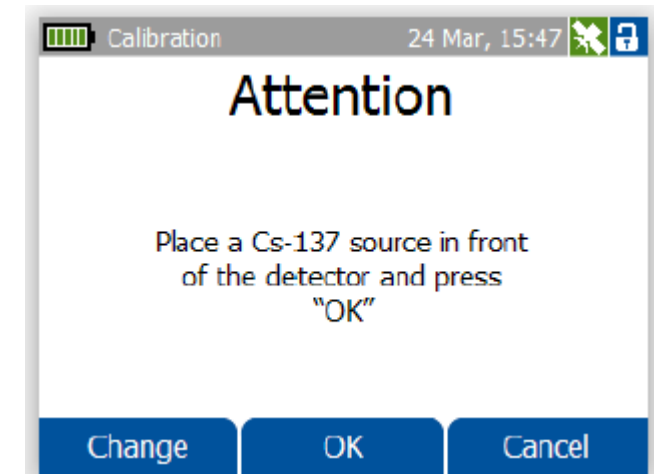
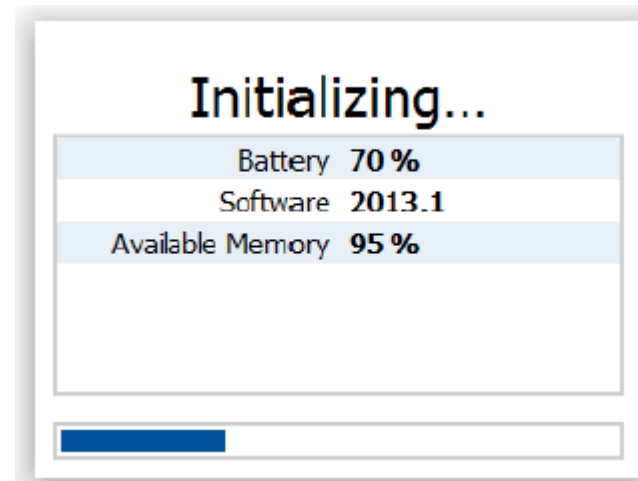
- Press ON/OFF button
  - the red ALARM lamp lights up
- During the boot sequence the display shows
  - Battery
  - Software version
  - Available memory
  - And performs the calibration



# Calibration

- During initialization the instrument measures the internal Cs-137 source for energy calibration
- If not interrupted calibration takes about 60 sec
- Calibration should be performed in low background area

- If there is no internal source the detector will ask for one





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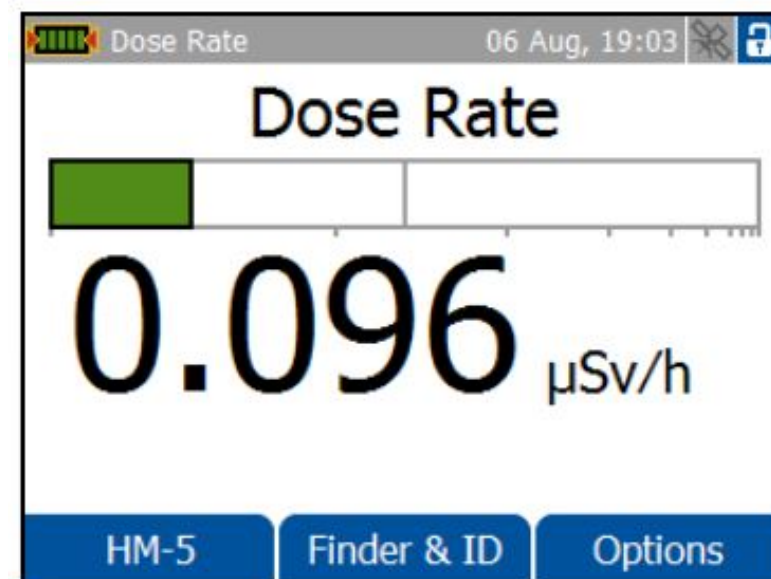
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## Dose Rate Mode

- Ambient dose rate equivalent
- Count rate per second
- At dose rates above 500  $\mu\text{Sv}$  instrument switches to GM-tube
- The unit can be changed to rem
  - Finder&ID > Finder > Dose Rate Settings > Dose rate settings

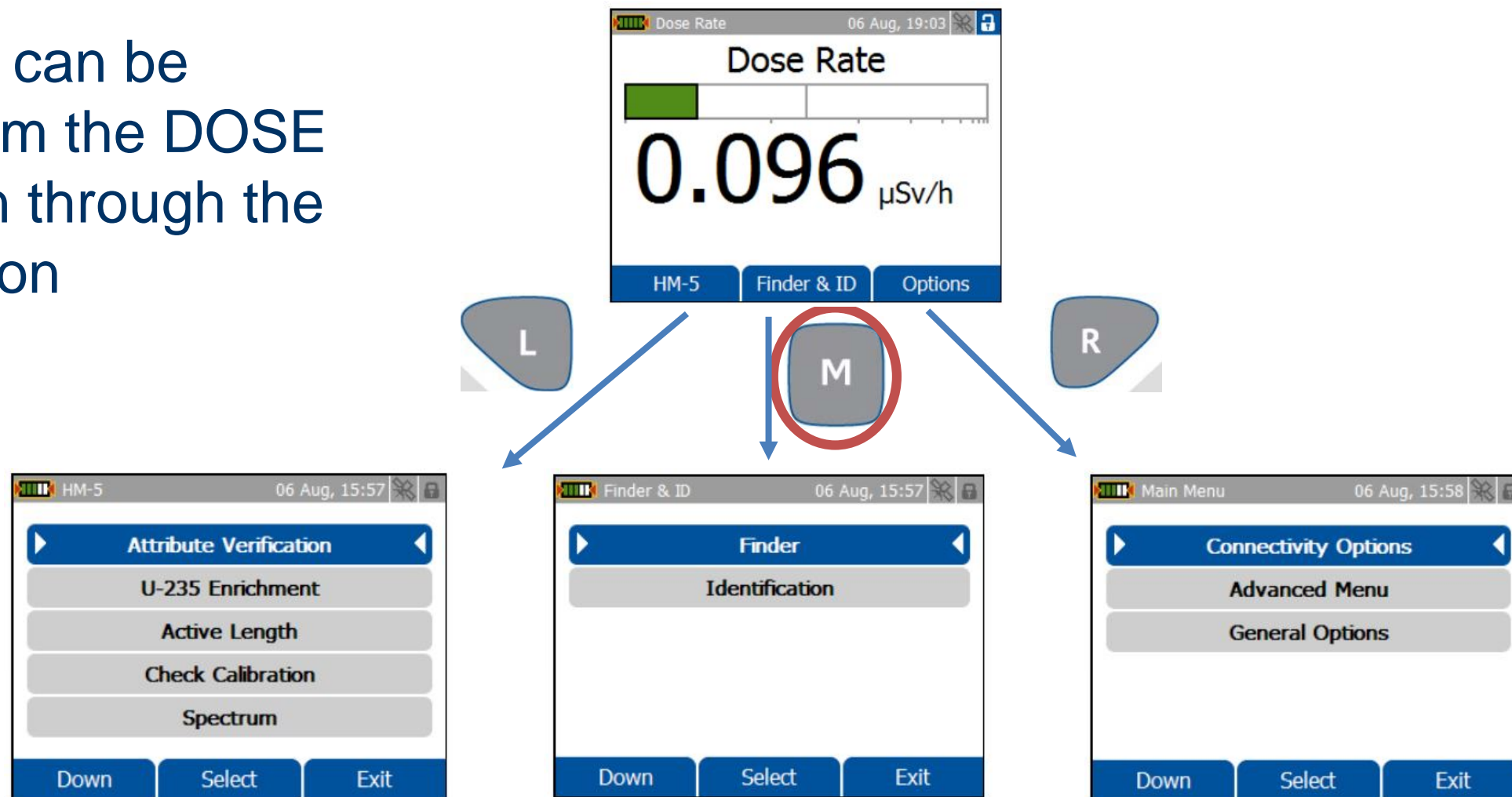






## Finder Mode

- Finder mode can be accessed from the DOSE RATE screen through the FINDER option



# Finder Mode



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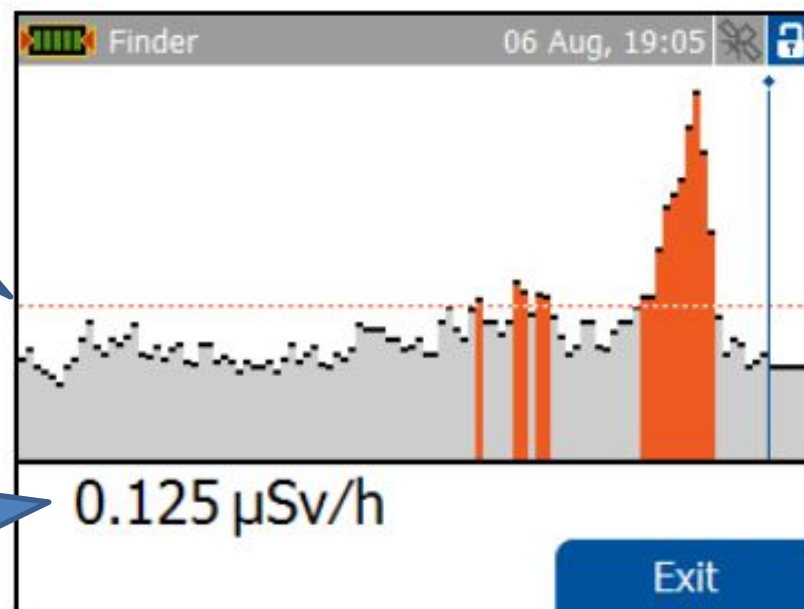
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Alarm threshold  
setting, 100% of  
the background

Dose  
rate  
reading



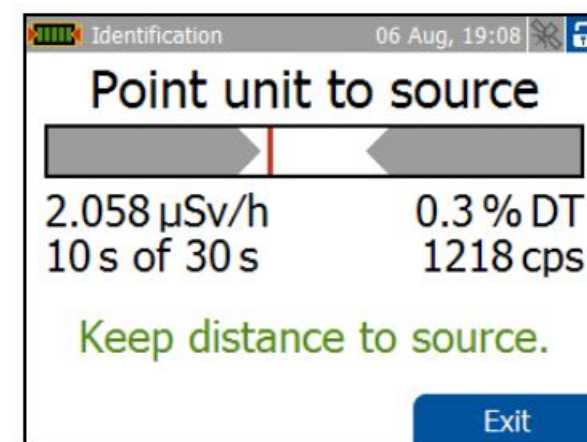
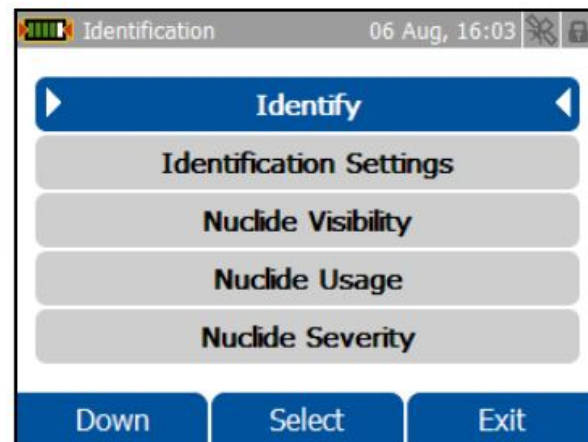
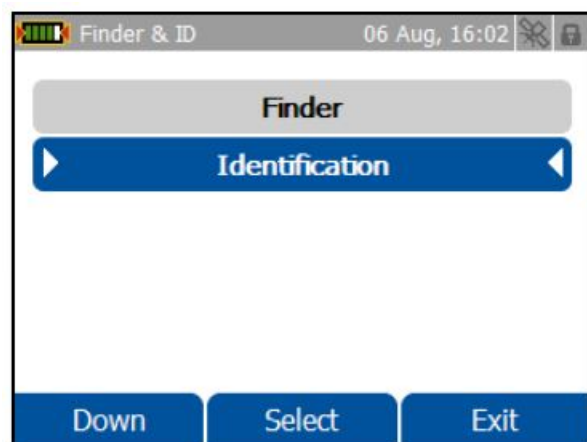
Vertical bar graph  
represents amount  
in dose rate





# Identification Mode

- Use 'L' (Down) to Select 'Identification'
- Use 'M' (Select) to initiate 'Identification'



Toggles between Finder  
and Identification



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# Successful Nuclide Identification

Level of confidence on  
a scale from 1 to 10

Identification 06 Aug, 19:11

## Nuclides

9	HEU	SNM	T
6	Co-60	IND	I

Identification saved as N° 337

Skip Send Exit

Severity:  
Threatening  
Suspicious  
Innocent

Nuclide Category:  
SNM – Special nuclear material  
Nuc – Former name for SNM  
Ind – Industrial  
NORM – Naturally occurring  
Radioactive Material  
Med – Medical



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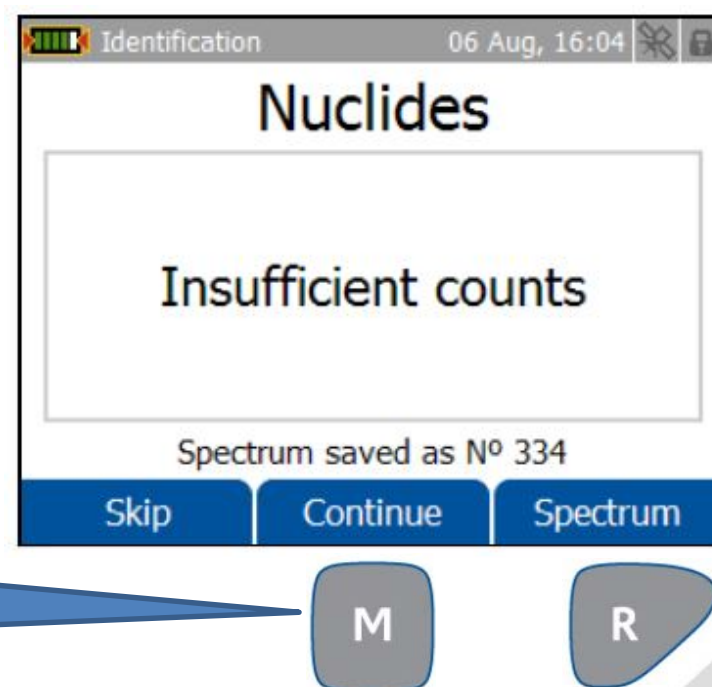
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## Activity Too Low

- If the instrument was not able to identify isotopes in the source then
  - Either continue counting another 30 s or
  - Exit and move closer to source



Continue acquiring  
spectrum

View current  
spectrum



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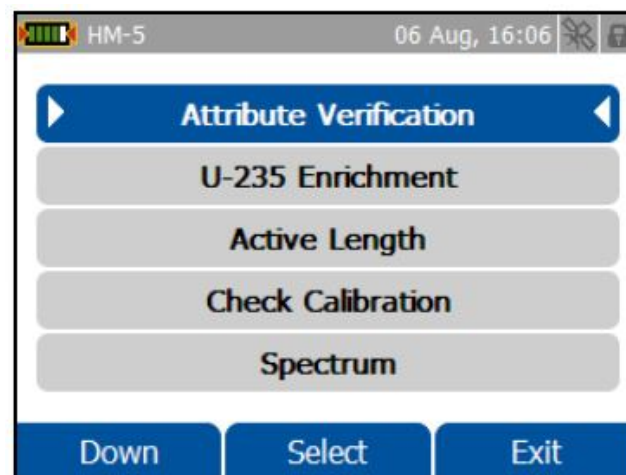
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## HM-5 Mode

- HM-5 mode includes specific nuclear safeguards applications:
  - Attribute verification – determine of presence of U, Pu or Th
  - Active length verification – verify material distribution in fuel and active length of fuel elements
  - U-235 enrichment – verify uranium enrichment using NaIGEM





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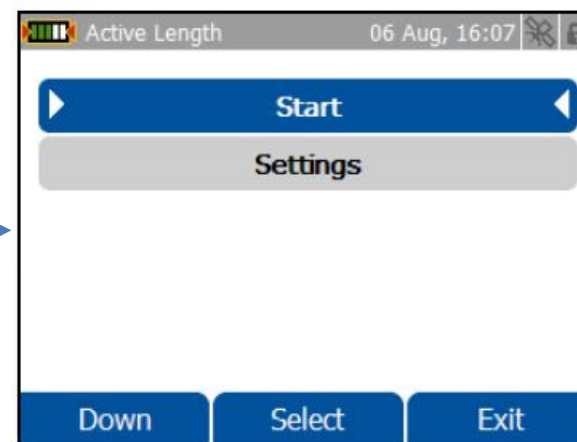
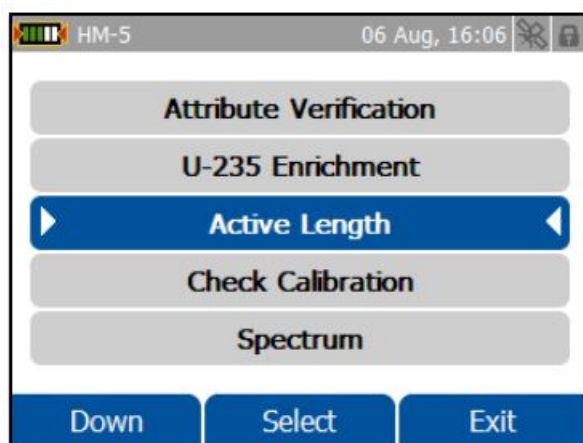
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## Active Length Verification

- Active length verification mode is used for verification of the presence of material in the fuel rod and its distribution





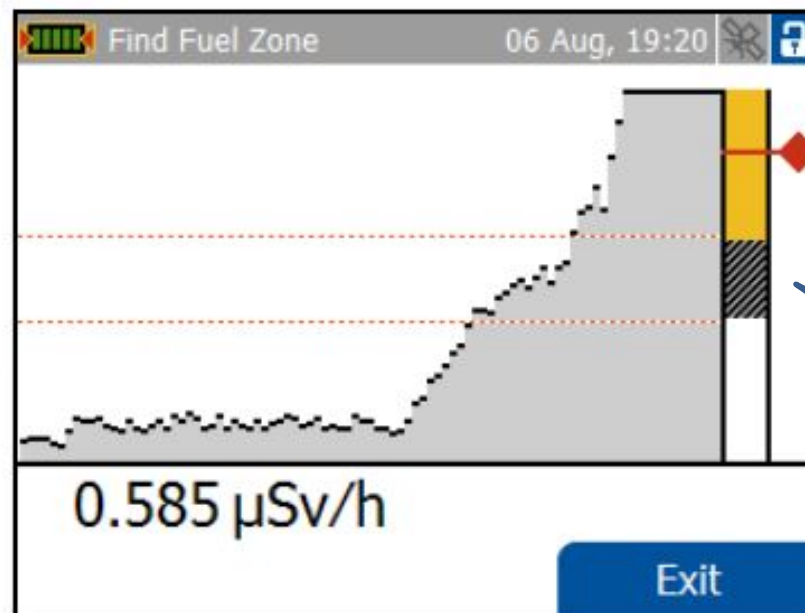
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# Active Length Measurements



Marker  
indicator

Corridor

- Take a spectrum of the fuel zone
- Spectrum outside the fuel zone
- Move slowly from the outside zone toward fuel zone
- The border of the fuel zone is reached when marker is in corridor



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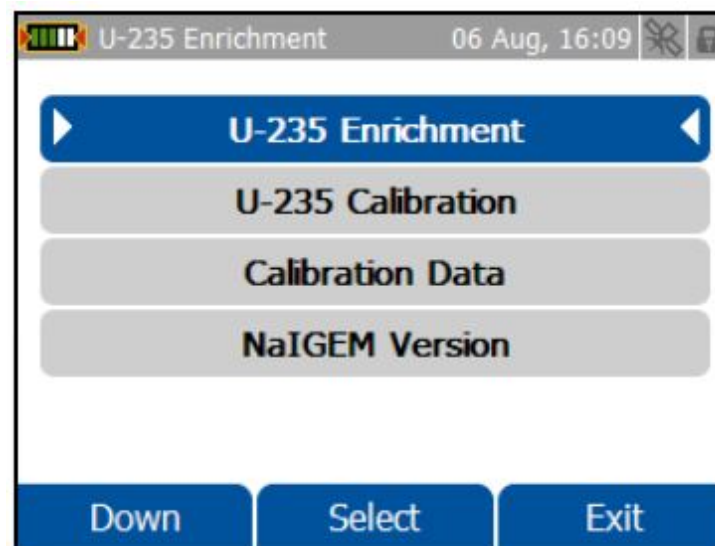
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# U-235 Enrichment Measurements

- identiFINDER uses special built-in version of NaIGEM software for U-235 enrichment measurements
- Usually Enrichment option in identiFINDER is used for confirmation enrichment measurements, for precise measurements a specialized system is recommended instead







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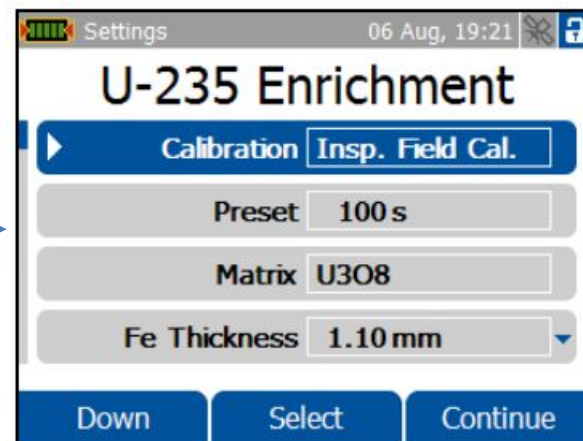
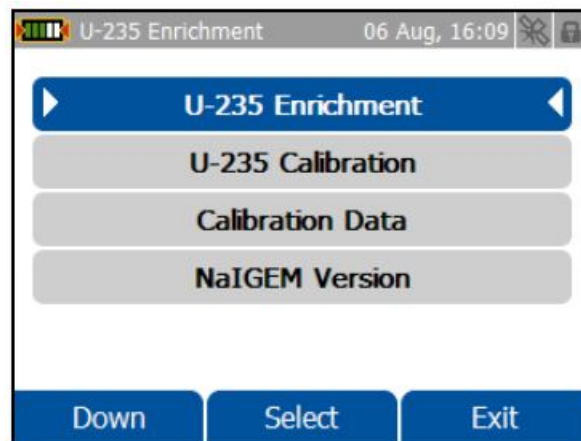
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# Measurement Parameters

- In Measurement Parameters section user can adjust:
  - Counting time
  - Fe thickness and density
  - Al and Cd thickness
  - Material matrix (metal,  $\text{U}_3\text{O}_8$ ,  $\text{UO}_2$ , etc.)







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## Calibration and Analysis

- U-235 enrichment analysis requires one-point calibration with the known source
- Analysis results are quoted in weight percent with relative and absolute errors quoted

U-235 Enrichment 06 Aug, 16:17

U-235 Enrichment

U-235 Calibration

Calibration Data

NaIGEM Version

Down Select Exit

Settings 06 Aug, 16:16

U-235 Calibration

Enrichment 91.000 wt %

Preset 300 s

Matrix U3O8

Fe Thickness 0.00 mm

Down Select Continue

U-235 Enrichment 06 Aug, 19:33

Enrichment Result

Weight %	88.087 %
Atom %	88.219 %
Relative Error (1 $\sigma$ )	$\pm 4.45$ %

Measurement saved as N<sup>o</sup> 341

Send Exit



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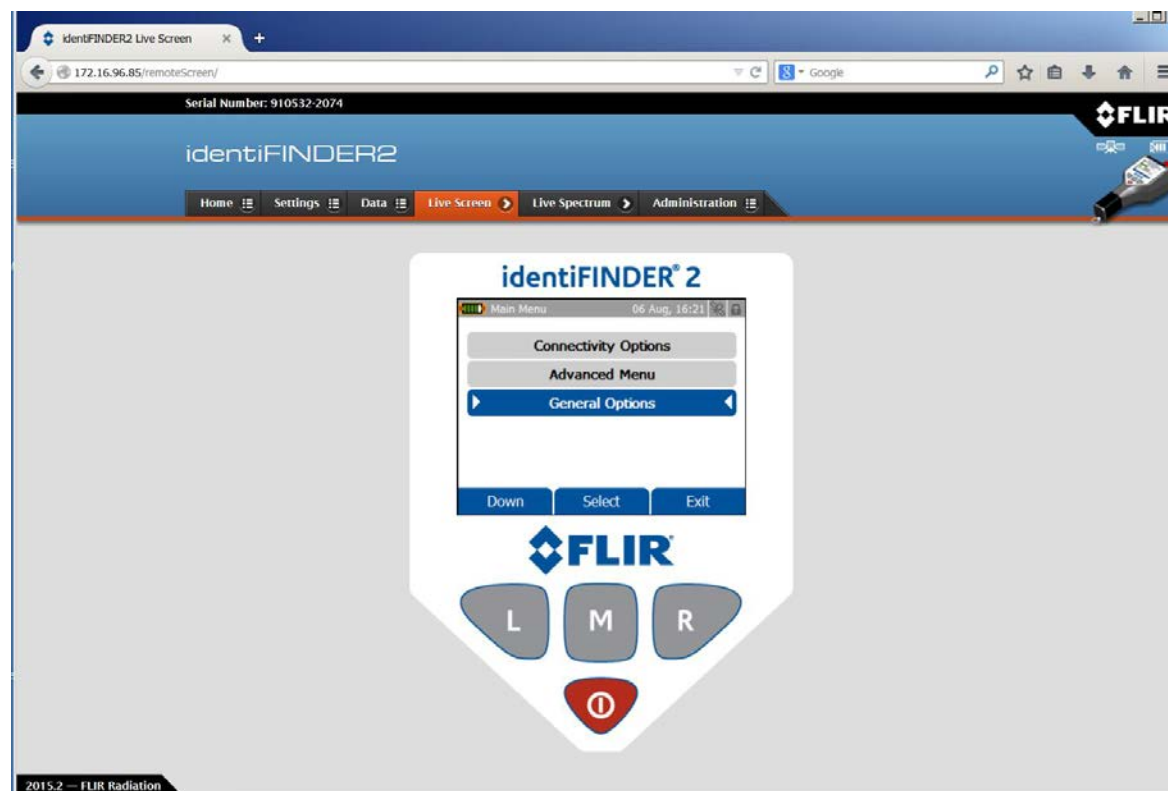
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## Connecting to a computer

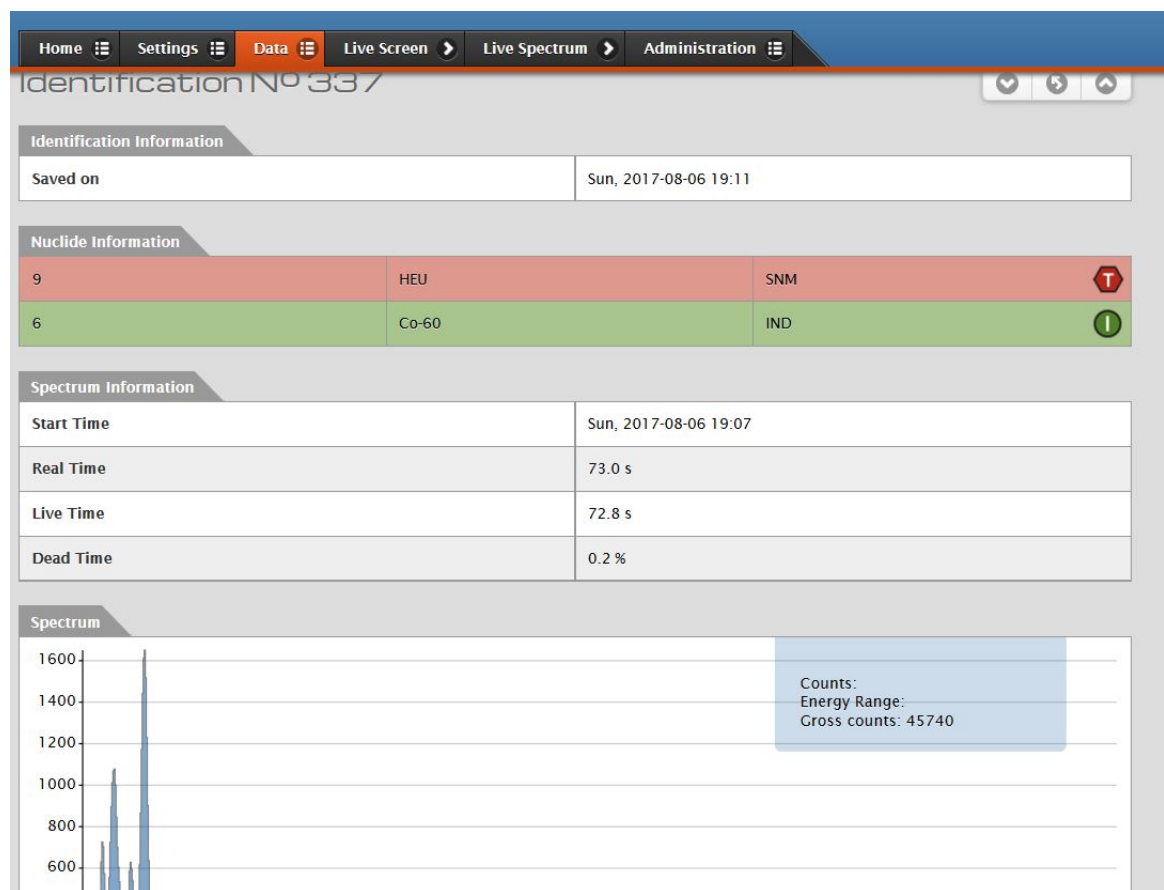
- Instructions will appear after connecting the device to a computer
- See the manual for more ways to transfer data





# View individual measurement details

- Select Data > Identification > Select measurement





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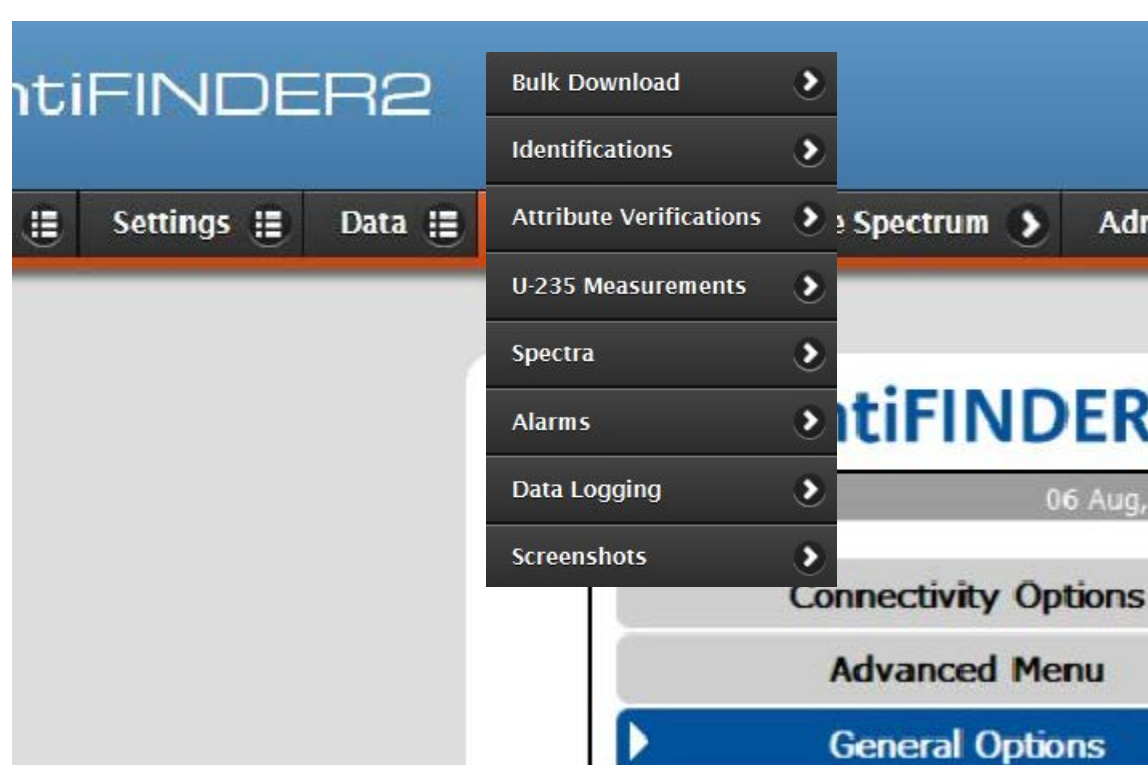
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# Bulk download of spectra

- Select Data > Bulk Download to save spectra to a computer for analysis



### Bulk Download

**Date Selection**

Today Yesterday This Week Last Week All

Start Date: 2017-06-01 End Date: 2017-08-07

To download all records, leave these fields empty.

**Data Types**

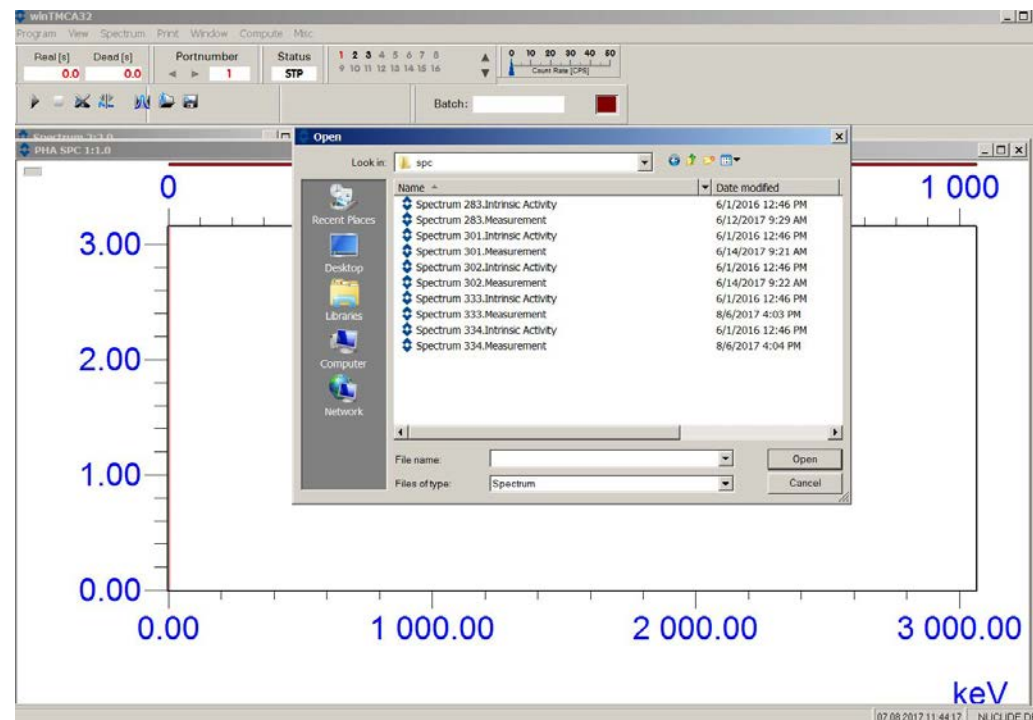
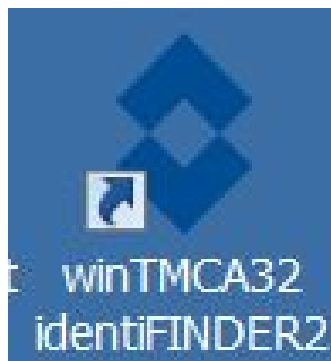
<input type="checkbox"/> Identifications	
<input type="checkbox"/> Attribute Verifications	
<input type="checkbox"/> U-235 Measurements	
<input checked="" type="checkbox"/> Spectra	Number of records: 5
<input type="checkbox"/> Alarms	
<input type="checkbox"/> Data Logging	
<input type="checkbox"/> Screenshots	

**Download**



# Analysis of spectra – winTMCA32

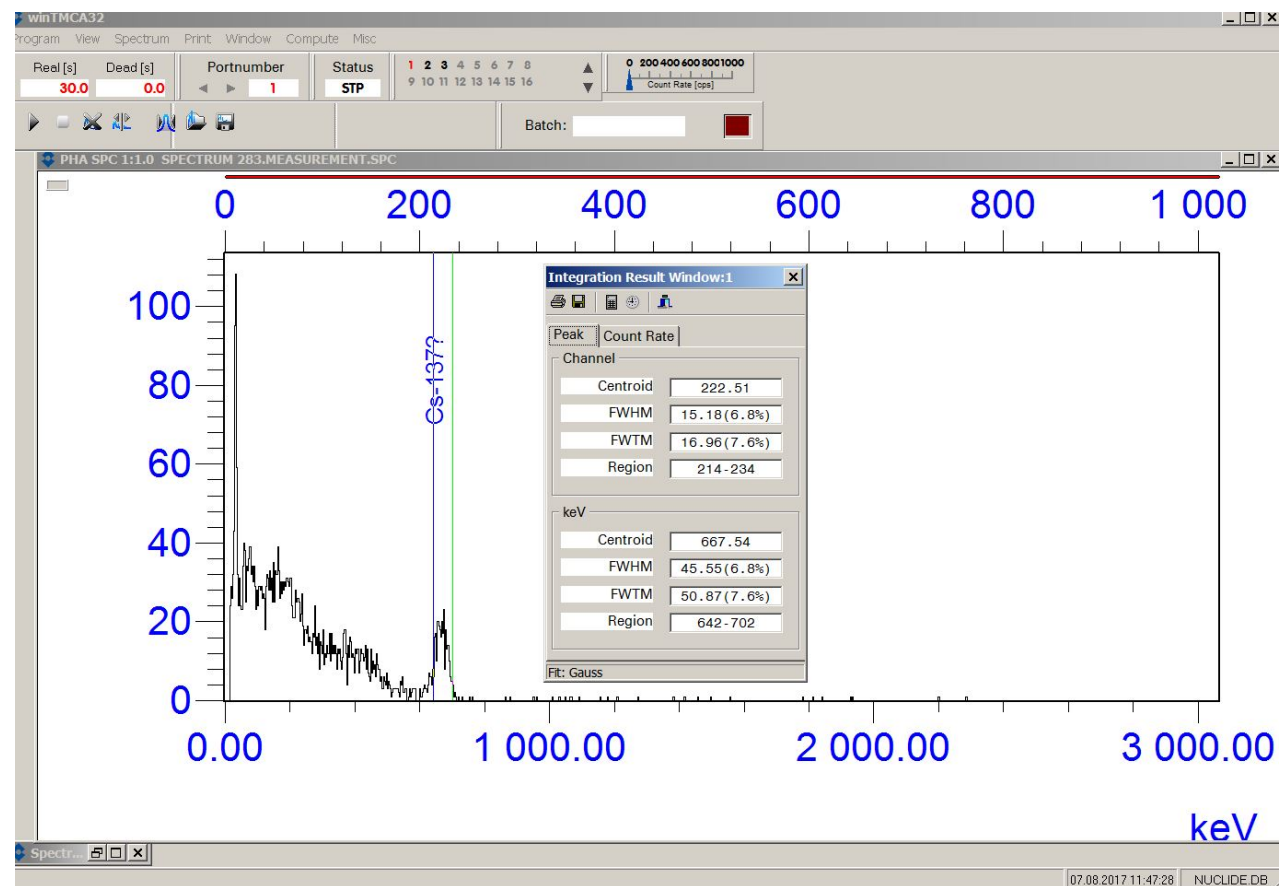
- Open winTMCA32 to analyze spectra on a computer
- Select Spectrum > Load to select a spectrum to view
- You must note the spectrum numbers of your measurement!





# Viewing spectrum

- Right click to add ROI markers







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# Summary

- The identiFINDER is a portable hand-held radionuclide detection and identification device
- Key safeguards applications of the identiFINDER:
  - Verify the presence of nuclear material and determine its location and distribution
  - Identify isotope(s) present
  - Uranium enrichment measurement (with NaIGEM software)
- identiFINDER exercises will include:
  - Use Dose Rate mode to measure gamma dose rate
  - Use Finder mode to find various sources
  - Use Identification mode to identify those sources



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# IDENTIFINDER

## Overview and Operation

**[Name of Course]**

**[Location and Date of Course]**

**[Name of Presenter]**

**[Professional Affiliation of Presenter]**

**[Release Organization and Number]**



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## References

- identiFINDER R 400 user manual. FLIR Corporation. Mar 2014.